Contribution to the identification of *Xylaria* species in Iran

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Seyed Abdollah Hashemi✉: PhD Student of mycology and plant pathology, Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, P.O. Box 41735-1314, Rasht, Iran (hashemiabdollah@yahoo.com)

Seyed Akbar Khodaparast: Associate Prof., Plant Protection, Faculty of Agricultural Sciences, University of Guilan, P.O. Box 41735-1314, Rasht, Iran

Rasoul Zare: Research Prof., Department of Botany, Iranian Research Institute of Plant Protection, P.O. Box 19395-1454, Tehran 1985813111, Iran

Seyed Ali Elahinia: Emeritus Prof., Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, P.O. Box 41735-1314, Rasht, Iran

Abstract

The preliminary result of a survey conducted on *Xylaria* species in the North of Iran is presented. Based on morphological examination of fungal specimens collected from Guilan, Mazandaran and Golestan provinces, eight species including *Xylaria arbuscula*, *X. cubensis*, *X. filiformis*, *X. hypoxylon*, *X. longipes*, *X. multiplex*, *X. pannosa*, and *X. polymorpha* were identified. Among the identified species, *X. hypoxylon*, *X. longipes*, and *X. polymorpha* have been already reported from Iran and the rest are new to the Iranian mycobiota. An identification key with brief description of all species already reported from Iran is presented.

Keywords: Ascomycetes, biodiversity, morphology, taxonomy, *Xylariaceae*

کمک به شناسایی گونه‌های *Xylaria* در ایران*

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سید عبداله هاشمی✉: دانشجوی دکتری قارچ‌شناسی و بیماری‌شناسی گیاهی، گروه گیاه‌پزشکی، دانشکده علوم کشاورزی، دانشگاه گیلان، رشت (hashemiabdollah@yahoo.com)

سید اکبر خداپرست: دانشیار گروه گیاه‌پزشکی، دانشکده علوم کشاورزی، دانشگاه گیلان، رشت

رسول زارع: استاد پژوهش بخش تحقیقات رستنی‌ها، مؤسسه تحقیقات گیاه پزشکی کشور، صندوق پستی ۱۹۳۹۵-۱۴۵۴، تهران ۱۹۸۵۸۱۳۱۱۱

سید علی الهی‌نیا: استاد بازنشسته گروه گیاه‌پزشکی، دانشکده علوم کشاورزی، دانشگاه گیلان، رشت

خلاصه

در این مقاله، نتایج مقدماتی مطالعه جنس *Xylaria* در شمال ایران ارایه می‌شود. براساس مطالعات ریخت شناسی نمونه های جمع‌آوری شده از استان‌های گیلان، مازندران و گلستان، تعداد هشت گونه شامل *Xylaria arbuscula*، *X. cubensis*، *X. filiformis*، *X. hypoxylon*، *X. longipes*، *X. multiplex*، *X. pannosa* و *X. polymorpha* شناسایی شد . به جز گونه های *X. hypoxylon*، *X. longipes* و *X. polymorpha* که قبلا از ایران گزارش شده‌اند، سایر گونه‌ها برای فلور قارچی ایران جدید می‌باشند. کلید شناسایی و توصیف مختصری از کلیه گونه‌ایی که تاکنون از ایران گزارش شده نیز ارایه می‌شود.

واژه‌های کلیدی: آسکومیست‌ها، تاکسونومی، تنوع زیستی، ریخت‌شناسی، *Xylariaceae*

* بخشی از رساله دکتری نگارنده اول به راهنمایی دکتر سید علی الهی‌نیا و دکتر رسول زارع ارایه شده به دانشگاه گیلان

Introduction

Xylaria Hill ex Schrank, type genus of *Xylariaceae* (Rogers & Ju 2012), is characterized by unipartite, usually multiperitheciate, upright, stipitate to sessile, variously-shaped stromata (Ju & Rogers 1999). Species of *Xylaria* can be found on numerous substrates such as fallen leaves, petioles, herbaceous stems, dung, grasses, seeds, fruits, wood and soil, but mostly grow on rotten wood (Rogers 1986, Rogers & Samuels 1986, Rogers *et al.* 1988, San Martin & Rogers 1989). The taxonomy of *Xylaria* species is more or less controversial due to the polymorphism of stromata color, size and shape that is mainly associated with developmental stages of stromata, locality, probable inherent variability, and also the cosmopolitan behavior of many species resulting in different descriptions of the same species in different stages of maturity (Rogers 1986). *Xylaria* is a large genus with about 560 legitimate species (MycoBank 2014) but some of them may be synonymous, however, no comprehensive monographic study is available on the genus.

The genus *Xylaria* has been studied in various regions of the world such as USA, Europe and Africa (Ellis & Everhart 1887a, b, Dennis 1956, 1957, 1958, 1961, 1964, Martin 1970, Rogers 1983, 1984a, b, 1985, 1986, Rogers & Samuels 1986, Rogers *et al.* 1988, San Martin & Rogers 1989, Callan & Rogers 1993, Laessøe & Lodge 1994, Rogers & Ju 1998, San Martín *et al.* 2001, Rogers *et al.* 2008, Rogers & Ju 2012). Studies on the genus in Asia are mostly limited to Southeast of the continent (Morgan-Jones & Lim 1968, Dargan 1982, Ju & Tzean 1985, Ju & Rogers 1999, Ju & Hsieh 2007, Kshirsagar *et al.* 2009, Yi–Fan & Lin 2011, Ju *et al.* 2012, Ma *et al.* 2012, Whalley *et al.* 2012, Hande & Hiwarale 2013, Ma *et al.* 2013).

Only a few species of *Xylaria* have been reported from Iran (Ershad 2009), including *X. hypoxylon* and *X. polymorpha* from Ardabil, Golestan and Mazandaran provinces (Arefipour *et al.* 2004, Daneshpazhuh 1980, Riedl & Ershad 1977, Soleimani 1976) and *Xylaria longipes* from Mazandaran province (Zare & Morid 2006, Zare & Asef 2008). The aim of this study, from which the preliminary results are presented here, was to ease the identification of *Xylaria* species in Iran using morphological traits.

Materials and Methods

Fungal specimens were collected from the southern Caspian coast in the North of Iran (latitude: 38º 26́–36º 07́, longitude: 48º 52́–30º 24́) including Guilan, Mazandaran and Golestan provinces. Observations and measurements were made from ascospores mounted in distilled water and asci in 10% lactic acid. Melzer's reagent was applied to examine the ascus apical ring. At least 30, 10 and 5 measurements were recorded for ascospores, asci and ascus apical rings, respectively. The ascus length includes the spore-bearing part and stipe. VANOX AHBS3 Olympus light-microscope was used to examine fungal structures. Photographs were taken using a BH2 Olympus light-microscope equipped with a SONY DSCHX1 digital camera, or a M1000 Leica light-microscope equipped with a Canon EOS 600D digital camera. Fungal species were determined morphologically according to relevant literature (Dennis 1956, 1957, 1958, 1961; Martin 1970, Rogers 1979, 1984b, 1986, Ju & Tzean 1985, Rogers & Callan 1986, Rogers & Samuels 1986, Rogers *et al.* 1988, San Martin & Rogers 1989, Rogers & Ju 1998, Ju & Rogers 1999, San Martín *et al.* 2001, Ju & Hsieh 2007, Rogers *et al.* 2008, Hladki & Romero 2010, Rogers & Ju 2012). Host plants were identified according to Mozaffarian (1998). All collected specimens are preserved at the Fungal Collection of the Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, Rasht, Iran (GUM).

Results and Discussion

Based on morphological studies of the fungal specimens recently collected from the North of Iran, eight species including *X. arbuscula*, *X. cubensis*, *X. filiformis*, *X. hypoxylon*, *X. longipes*, *X. multiplex*, *X. pannosa*, and *X. polymorpha* were identified. Among

these, three species including *X. hypoxylon*, *X. longipes* and *X. polymorpha* have been already reported from Iran, and the rest are new records to the Iranian mycobiota. An identification key together with a brief description of Iranian species is presented here.

Key to *Xylaria* species already known from Iran

1. Stromata on herbaceous stem, solitary, filiform, 58–72 mm long, 1(–2) mm diam., with naked solitary perithecia; ascospores (12.5–)13–16(–21) × (4.5–)5(–5.5) µm with straight spore-length germ-slit ..... ***X. filiformis***
1. Stromata on wood, combination of characters differing from above 2
2. Stromata usually 5 mm diam. or greater 3
2. Stromata usually smaller than 5 mm diam. 7
3. Stromatal surface more or less smooth (plane), except for ostioles 4
3. Stromatal surface more or less roughened with perithecial contours, coarse ostiolar papillae, wrinkles, deep cracking, warts, or combination of these features 5
4. Stromata usually becoming hollow at or prior to maturity.....***X. cubensis***
4. Stromata not becoming hollow .....***X. pannosa***
5. Ascospores with spiraling germ-slit, (11.5–)12–14.5(–16) × (4.5–)5-6(–7) µm.....***X. longipes***
5. Ascospores with straight to slightly oblique germ-slit 6
6. Ascospores (9.5–)10–12.5(–13) × 4.5–5(–5.5) µm, with straight nearly spore-length germ-slit ..... ***X. hypoxylon***
6. Ascospores (17.5–)18–24(–26) × (5.5–)6–8(–9) µm, with straight to slightly oblique germ-slit about ½ spore-length .....***X. polymorpha***
7. Stromata caespitose; with 6–10 mm long stipe; ascospores 10–13(–14) × (4–)5(–6) µm, with straight spore-length germ-slit ..... ***X. multiplex***
7. Stromata solitary to gregarious, with very short to long stipe; ascospores 12–16(–17) × 5–6 µm, with straight ½–¾ spore-length germ-slit ..... ***X. arbuscula***

Xylaria arbuscula Sacc., Michelia 1(2): 249 (1878) **(Fig. 1)**

Stromata solitary to gregarious, unbranched or branched near apex, (3.4–)4.2–54 mm high × 1.3–2.5(–3.5) mm broad, with very short to long stipe, fertile portion cylindrical with acute sterile apices (Figs 1A, B); stromatal surface black to brownish black with light brown to black peeling outer layer (Figs 1C, D); perithecia completely immersed, 300–550 µm diam.; ostioles slightly papillate to inconspicuous; asci 8-spored, 125–180 µm long × (5.5–)6.3–7(–10) µm broad, the spore-bearing part 70–90 µm long, with apical ring bluing in Melzer's iodine reagent (amyloid), inverted hat shape, (3–)3.5–4 × 2–3(–3.5) µm (Fig. 1F); ascospores 12–16(–17) × 5–6 µm, inequilateral, young spores occasionally apiculate at one end, brown, with straight ½–¾ spore-length germ-slit (Fig. 1E).

Specimens examined: Iran: Guilan province, Visrood road, Shaft, on unknown decaying wood, 4 Oct. 2012, M. Mousakhah (GUM 1033); Saravan forest park, Rasht, on decaying wood of *Alnus* sp., 18 Oct. 2012,S.A. Hashemi

(GUM 1034); Kooshal village, Lahijan, on decaying wood of *Alnus* sp., 26 Oct. 2012, S.A. Hashemi (GUM 1035).

Note: *Xylaria arbuscula* is a complex species (San Martin & Rogers 1989, Rogers & Ju 2012), and has been recorded on a large variety of hosts. In this study it has either short to nearly inconspicuous unbranched stipe with one fertile portion or sometimes long stipe branched near the apex with a fertile portion of stromata forming a dense cluster on a common stalk. *Xylaria arbuscula* differs from *X. multiplex* by having larger ascospores with ½–¾ spore-length germ-slit, and often the lack of caespitose stromata. Martin (1970) assigned ascospores with prominent gelatinous sheaths to this species; however, it was absent in our examined specimens. This is the first record of *X. arbuscula* form Iran.

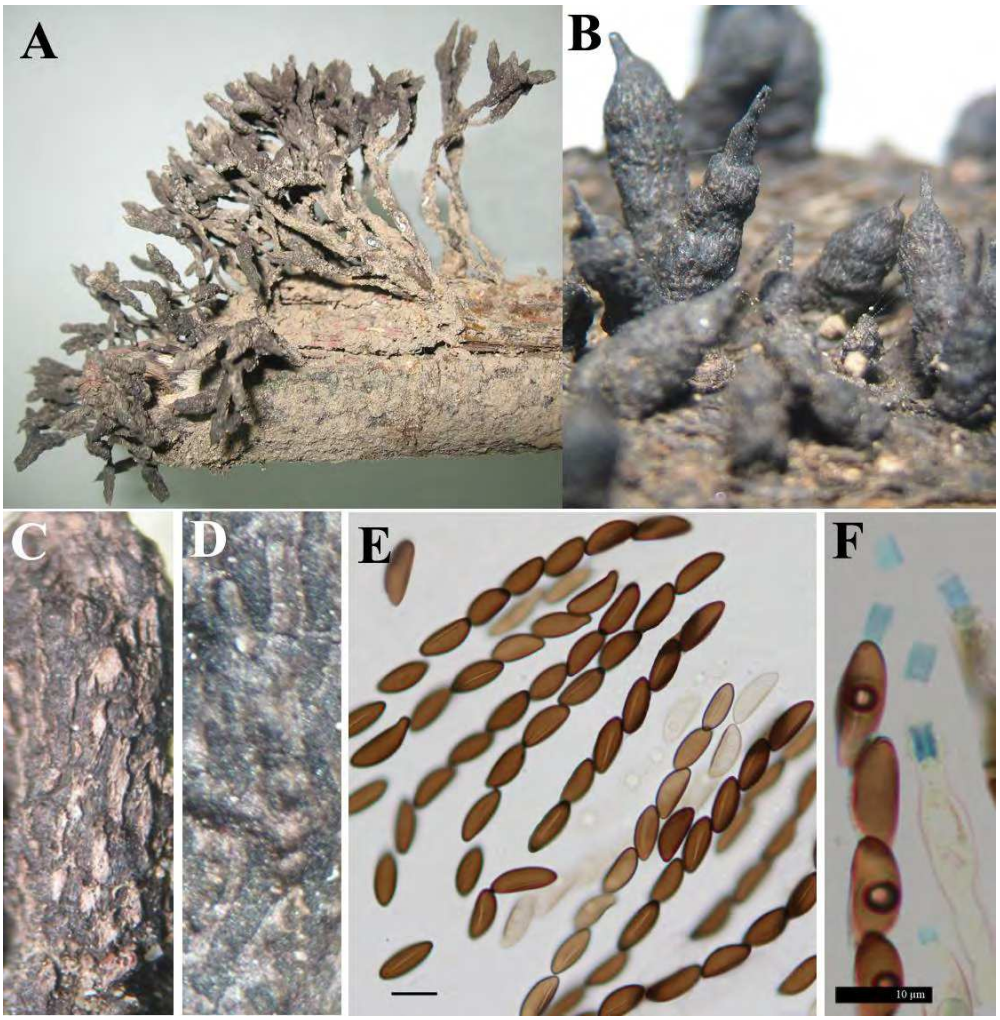

Fig. 1. *Xylaria arbuscula*: A–B. Stromata on wood, C–D. Stromatal surface, with distinctive peeling outer layer, E. Ascospores, F. Asci with apical ring bluing in Melzer's reagent (Bars = 10 µm).

Xylaria cubensis (Mont.) Fr., Nova Acta R. Soc. Scient. upsal., Ser. 31(1): 126 (1851) **(Fig. 2)**

Stromata solitary, cylindric-clavate, usually unbranched, 15–50(–65) mm high × (3.7–)4–11(–12.5) mm broad, with short or long stipe from a pannose base, fertile portion copper-colored to blackish brown, becoming hollow at maturity (Figs 2A–D), with rounded fertile apices (Fig. 2G), stromatal surface smooth except for ostioles or tiny cracks (Figs 2E, F); perithecia completely immersed, 500 µm diam.; ostioles more or less finely papillate; asci 8-spored, stipitate, 88–133 µm long × 7 µm broad, the spore-bearing part 60 µm long, with apical ring bluing in Melzer's iodine reagent, cylindrical, 3 × 2 µm (Fig. 2I); ascospores brown, ellipsoid-inequilateral, smooth, (7–)8–9.5(–11) × 4–5(–6) µm, mostly without germ-slit or rarely with straight

nearly spore-length germ-slit (Fig. 2H). Anamorphic state, synnemata, produces separately from teleomorphic state on wood. Synnemata flabellate, pinkish colored (Fig. 2J), with dense layer of sparsely branched conidiophores (Fig. 2L). Conidia produced sympodially on conidiogenous cells, pinkish in mass, one-celled, 4.5–6 × 2–2.5 µm, hyaline, obovate to ellipsoidal with flattened base at one end (Fig. 2K).

Specimens examined: Iran: Guilan province, Saravan forest park, Rasht, on decaying wood of *Quercus* sp., 9 April 2012 (GUM 1036), and on unknown decaying wood (GUM 1037); Mazandaran province, Kelardasht, on decaying wood of *Diospyros lotus*, 2 Jun. 2012 (GUM 1038, 1039, 1040), and on unknown decaying wood (GUM 1041); 8th km of Astara-Ardabil road, Astara, Guilan province, on unknown decaying wood, 10 Jul. 2012 (GUM 1042, 1043, 1044, 1045); Lavandevil, Astara, on unknown decaying wood, 11 Jul. 2012 (GUM 1046); Saravan forest park, Rasht, on decaying wood of *Parrotia persica*, 13 Aug. 2012 (GUM 1047, 1048); Mazandaran province, Tilakenar, Salmanshahr, Chaloos, on decaying wood of *Gleditschia caspica*, 9 Sept. 2012 (GUM 1049); Guilan province, Sefidab village, Rahim Abad, Roodsar, on unknown decaying wood, 19 Oct. 2012 (GUM 1050); Lonak, Lahijan, on unknown decaying wood, 9 Nov. 2012 (GUM *1051*). All collected by S.A. Hashemi.

Note: *Xylaria cubensis* is mainly chracterized by its smooth, copper-colored stromata with rounded fertile apices and small ascospres mostly without germ-slit (Rogers 1984b). This species has been divided into two types, A and B, base on color and size of stromata and color and shape of ascospore. (Ju & Tzean 1985). This fungus differs from *X. pannosa* Lloyd, the closest species, by having hollow stromatal flesh at or prior to maturity (Lloyd 1918, Rogers & Ju 2012). This species is a new record from Iran.

Xylaria filiformis (Alb. & Schwein.) Fr., Summa veg. Scand., Section Post. (Stockholm): 382 (1849) **(Fig. 3)**

Stromata solitary, filiform, mostly unbranched but occasionally two stromata arising from a common base, 58–72 mm long × 1(–2) mm diam. (Fig. 3A, C); perithecia intercalary, solitary, with distinct perithecial contours, (400–) 560–670 µm diam.; ostioles papillate; stromatal surface roughened with peritecial counters, dark brown to black (Fig. 3B); asci cylindrical, 8-spored, 130–155 µm long × 5.5–6.2 µm broad, the spore-bearing part 80–102 µm long, with apical ring bluing in Melzer's iodine reagent, inverted hat shaped, 2.8–3 × 1.8–2 µm (Fig. 3E); ascospores uniseriate with overlapping ends, (12.5–)13–16(–21) × (4.5–)5(–5.5) µm, inequilateral, flat on one side and round on the other, light brown, with straight spore-length germ-slit (Fig. 3D).

Specimen examined: Iran: Guilan province, Ghaleh-Roudkhan, Fouman, on herbaceous stem of undetermined plant, 11 Oct. 2012, S.A. Hashemi (GUM 1052).

Note: The specimen examined in this study has the same characters of *X. filiformis* described by Rogers & Samuels (1986) and Rogers (1986) but slightly deviates from the description of Ellis & Everhart (1887a) by having longer and narrower asci (vs 75–80 × 7–8 µm) and narrower ascospores (vs. 14–18 × 8–8.5 µm). *Xylaria schwackei* Henn., the closest species to *X. filiformis*, is distinguished by more strap-like stromata (Dennis 1956) with conspicuous perithecial contours, surface ornamented with sparsely distributed stiff hairs and the outer layer wearing off so early (only the occasional remnants are visible on mature stromata) (Ju & Rogers, 1999). *Xylaria filiformis* mostly occurs on decaying leaves of dicotyledonous trees and less often on other herbaceous debris (Ellis & Everhart 1887a, Rogers & Samuels 1986). This is the first record of *X. filiformis* for the Iranian mycobiota.

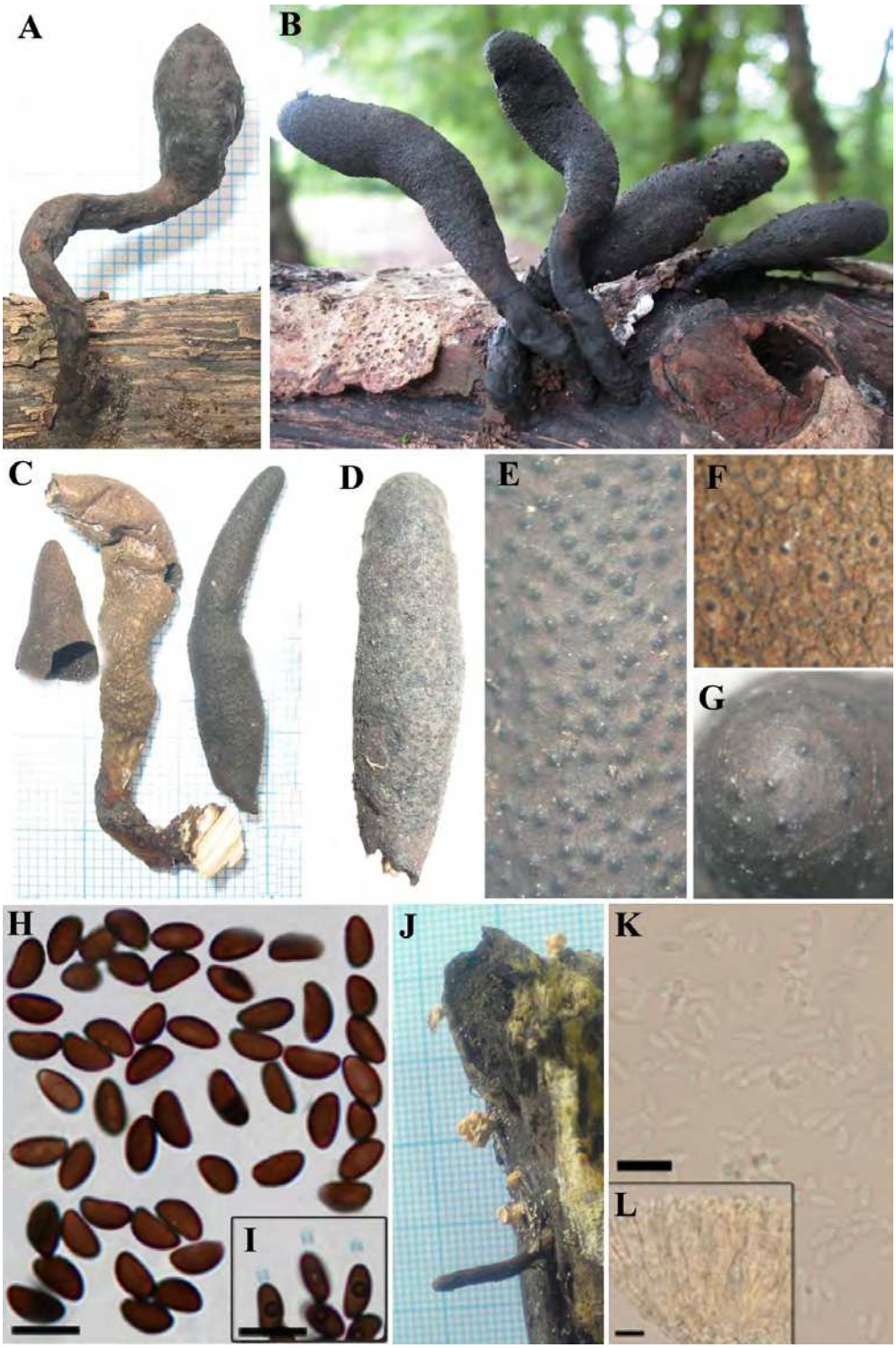

Fig. 2. *Xylaria cubensis*: A–D. Stromata, E–F. Smooth surface of mature and young stromata, respectively, G. Fertile tip of stromata, H. Ascospores, I. Ascus apical ring bluing in Melzer's reagent, J. Anamorphic and teleomorphic states on wood, K–L. Conidia and conidiophores, respectively (Bars = 10 µm).

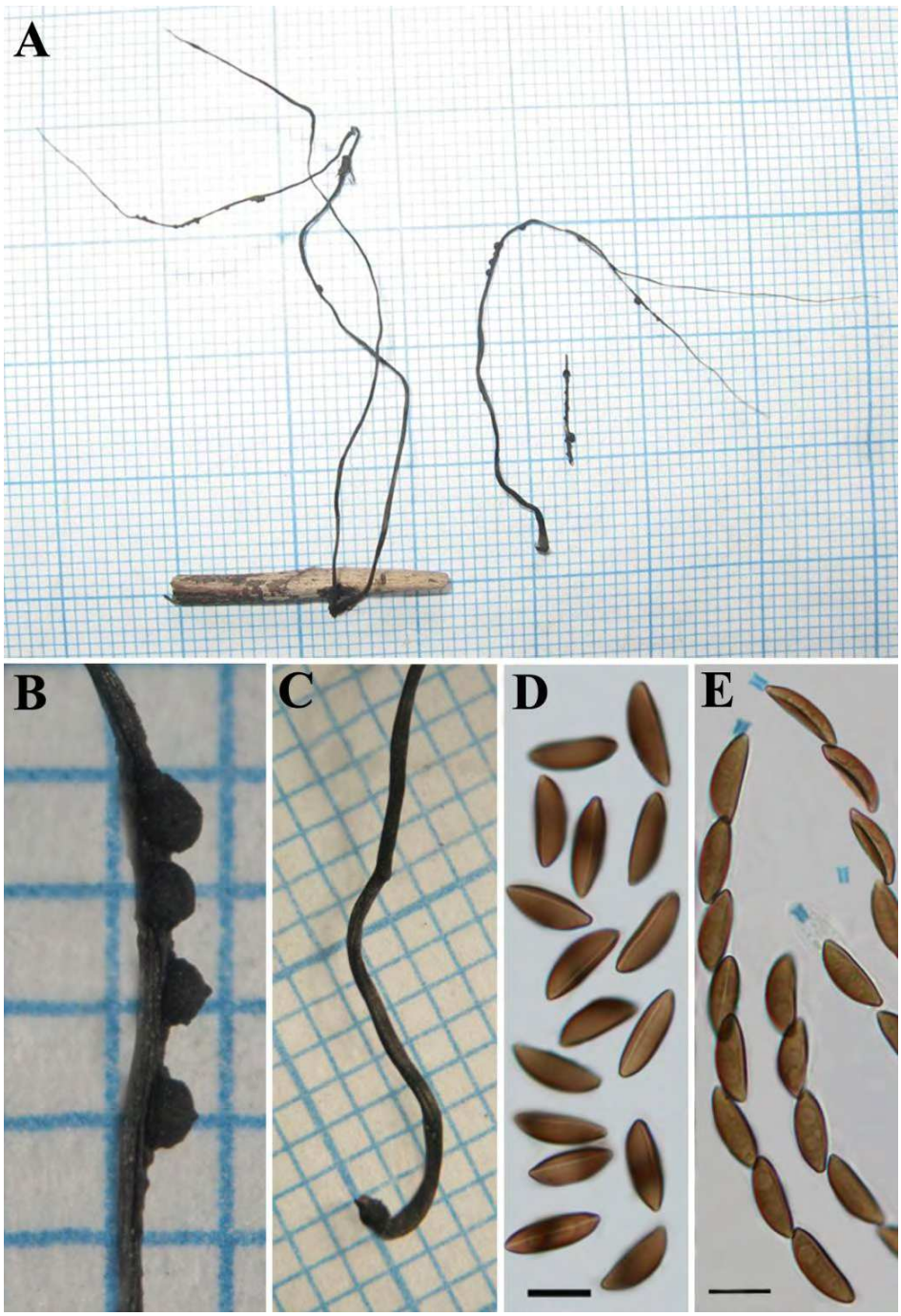

Fig. 3. *Xylaria filiformis*: A. Stromata, B. Naked perithecia, C. Stipe of stromata, D. Ascospores, E. Ascus apical ring bluing in Melzer's reagent (Bars = 10 µm).

Xylaria hypoxylon (L.) Grev., Fl. Edin.: 355 (1824) **(Fig. 4)**

Stromata solitary, ubconical, often branched and flattened toward the apex, 35 mm high × 6 mm diam., at first white, becoming dull black, internally white (Figs 4A, B); perithecia immersed; ostioles papillate; asci 8-spored, stipitate, 150–182 µm long × 5.5–6.5 µm broad, the spore-bearing part 75–80 µm long, with apical ring bluing in Melzer's iodine reagent, rectangular to urn shape, (2.5–)3(–3.5) × (2–)2.5 µm (Fig. 4D); ascospores brown, ellipsoid-inequilateral, (9.5–)10–12.5(–13) × 4.5–5(–5.5) µm, with straight nearly spore-length germ-slit (Fig. 4C).

Specimen examined: Iran: Guilan province, Deilaman, Lahijan, on undetermined decaying wood, 18 Aug. 2012, M.J. Pourmoghadam (GUM 1053).

Note: *Xylaria hypoxylon* has been previously reported from Golestan and Mazandaran provinces of Iran (Daneshpazhuh 1980, Arefipour *et al.* 2004). The specimen examined in this study has ascospores with the same characters of *X. hypoxylon* described by Ellis and Everhart (1887a), but somewhat shorter than that of Rogers & Samuels (1986) and Rogers *et al.* (2008).

Xylaria longipes Nitschke, Pyrenomyc. Germ. 1: 14 (1867) **(Fig. 5)**

Stromata cylindrical to clavate with fertile apex mostly unbranched but occasionally up to two stromata arising from a common base, dull blackish brown with light brown polygonal scales, (13.5–)21–55 mm high × (2–)3.5–7(–10) mm broad; stromatal surface roughened by polygonal scales (Fig. 5A–E); perithecia completely immersed, 460–660 µm diam.; ostioles slightly papillate to indistinct; asci stipitate, 148–193 µm long × 6–10 µm broad, the spore-bearing part 52–80(–92) µm long, with apical ring bluing in Melzer's iodine reagent, rectangular to inverted hat shape, (2–)2.5–3 × (2–)2.5–3 µm (Fig. 5G); ascospores brown, ellipsoid-inequilateral, (11.5–)12–14.5(–16) × (4.5–)5–6(–7) µm, with spiraling germ-slit (Fig. F).

Specimens examined: Iran: Guilan province, Saravan forest park, Rasht, on undetermined fallen wood, 13 Aug. 2012 (GUM 1054, 1055); Mazandaran province, Kashpel forest park, Chamestan, Noor, on fallen wood of *Parrotia persica* 10 Sept. 2012 (GUM 1056); Golestan province, Naharkhoran forest park, Gorgan, on undetermined fallen wood, 12 Sept. 2012 (GUM 1057, 1058). All collected by S.A. Hashemi.

Note: *Xylaria longipes* has been mostly reported in association with *Acer* spp. in northeastern USA and Europe (San Martin & Rogers 1989); however, it is reported on wood of *Parrotia persica* herein. *Xylaria longipes* has been previously reported from Mazandaran province of Iran (Zare & Morid 2006, Zare & Asef 2008).

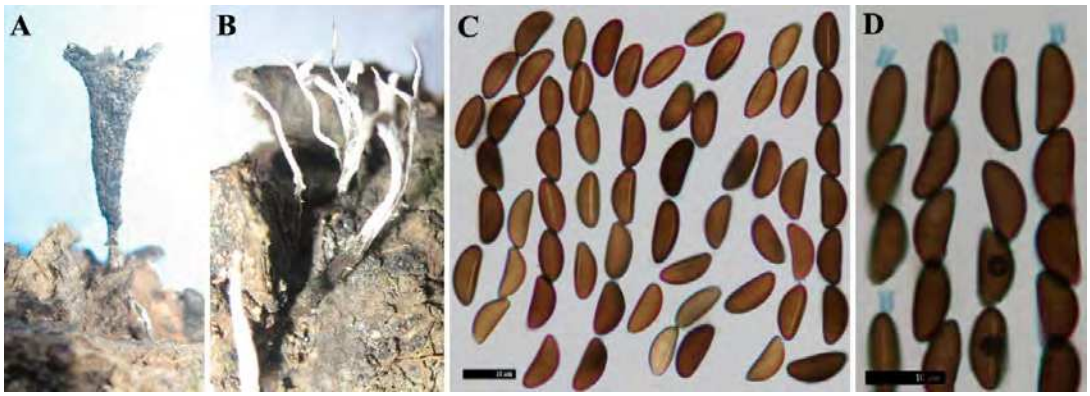

Fig. 4. *Xylaria hypoxylon*: A–B. Mature and young stromata on wood, respectively, C. Ascospores, D. Ascus apical ring bluing in Melzer's reagent (Bars = 10 µm).

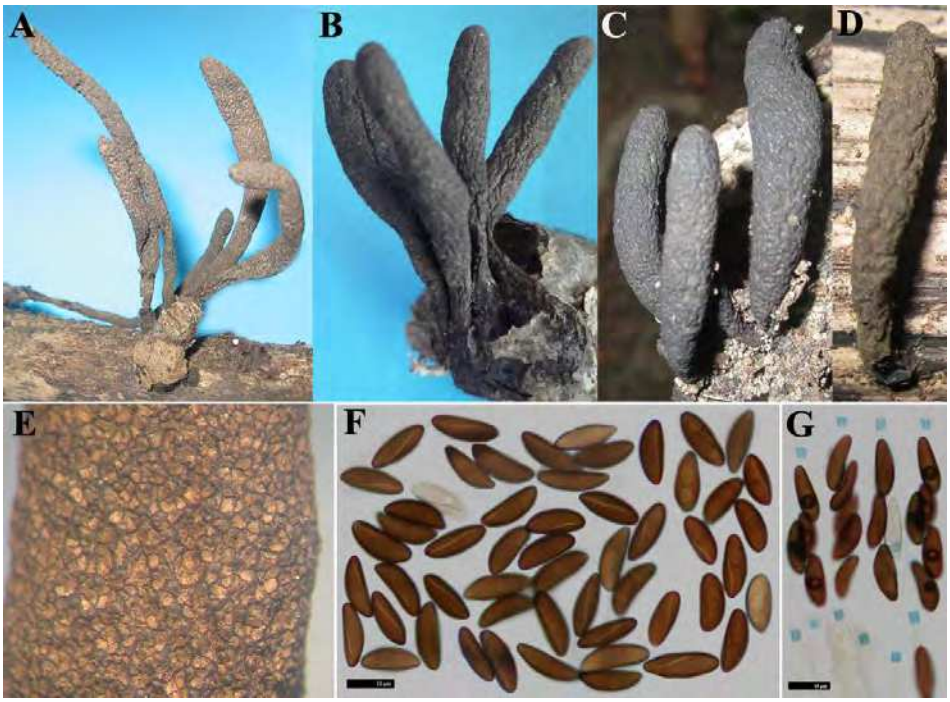

Fig. 5. *Xylaria longipes*: A–D. Stromata on wood, E. Close-up of stromatal surface with distinctive brown and polygonal plaques, F. Ascospores, G. Ascus apical ring bluing in Melzer's reagent (Bars = 10 µm).

Xylaria multiplex (Kunze) Fr., Nova Acta R. Soc. Scient. upsal., Ser. 31(1): 127 (1851) **(Fig. 6)**

Stromata solitary or branched, 1–2(–5) fertile parts on each stipe, cylindrical with acute sterile apices, (9–)16–25(–29) mm high × (1.3–)1.5–3 mm broad, caespitose, stipe 6–10 mm long, fertile portion dull blackish brown (Fig. 6A); perithecia completely immersed, 300–500 µm diam.; ostioles papillate (Fig. 6B, C); asci 8-spored, 125–150 µm long × 6–7µm broad, the spore-bearing part 70–77 µm long; with apical ring bluing in Melzer's iodine reagent, quadrate to inverted hat shape, 2 × 1.5–2 µm; ascospores 10–13(–14) × (4–)5(–6) µm, inequilateral with rounded apices, light brown with straight spore length germ-slit (Fig. 6D).

Specimens examined: Iran: Guilan province, Saravan forest park, Rasht, on undetermined decaying wood, 9 April 2012 (GUM 1059), and on fallen wood of *Quercus* sp. (GUM 1060). Both collected by S.A. Hashemi.

Note: *Xylaria multiplex* is mainly differentiated from *X. arbuscula* by shorter ascospores with germ-slit extending over the whole length (San Martin & Rogers 1989). It is a new record to the Iranian mycobiota.

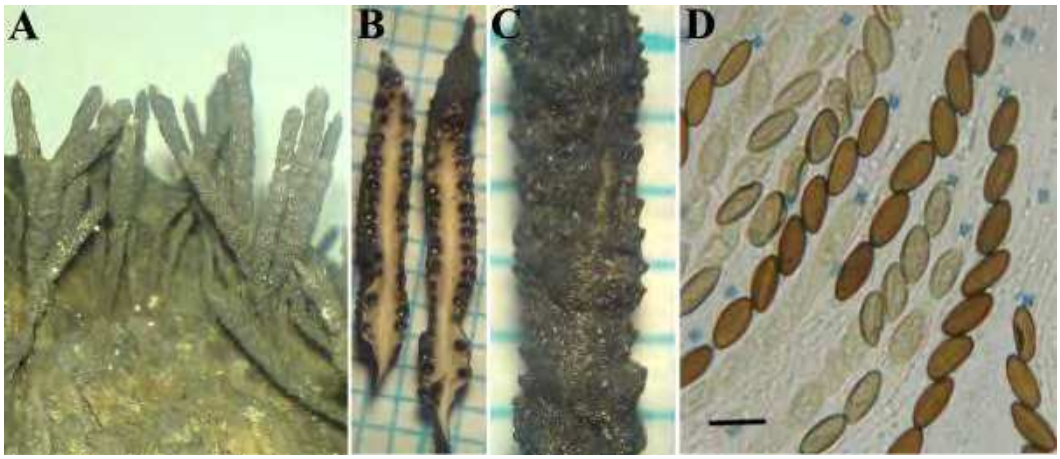

Fig. 6. *Xylaria multiplex*: A. Stromata on wood, B. Longitudinal section of stromata, C. stromatal surface with distinctive papillate ostioles, D. Ascospores and asci with apical ring bluing in Melzer's reagent (Bars = 10 µm).

Xylaria pannosa Lloyd, Mycol. Wri. 5: *Xylaria* Notes 1: 8 (1918) **(Fig. 7)**

Stromata solitary, usually unbranched, rarely branched from fertile part,clavate, occasionally cylindrical to ellipsoid, with rounded fertile apices, (10–)15–55 mm high × (3.5–)4–9(–11.5) mm diam., with short to long stipe arising from pannose base, copper-colored to blackish brown, internally white, not becoming hollow (Figs 7A–E); stromatal surface smooth except for tiny cracks and ostioles (Figs 7F–G); perithecia completely immersed, 400–600 µm diam.; ostioles papillate to hemispherical; asci 120–175 µm long × 5.5–7 µm broad, the spore-bearing part 50–70(–95) µm long, with apical ring bluing in Melzer's iodine reagent, rectangular, (1.5–)2–2.5 × 2 µm broad (Fig. 7I); ascospores brown, ellipsoid-inequilateral, (7.5–) 8–9(–10) × 4–5(–5.5) µm, mostly without germ-slit or very rarely with straight nearly spore-length germ-slit (Fig. 7H). Anamorphic state of this species is similar to those described herein for *X. cubensis* (Fig. 7J–L).

Specimens examined: Iran: Guilan province, Visrood, Shaft, on decaying wood of *Castanea sativa*, 23 Oct. 2011 (GUM 1061); 8th km of Astara-Ardabil road, Astara, on undetermined decaying wood, 10 Jul. 2012 (GUM 1062, 1063); Lavandevil, Astara, on undetermined decaying wood, 11 Jul. 2012 (GUM 1064, 1065, 1066); Shabkhosla village, Lahijan, on decaying wood of *Acer velutinum*, 5 Aug. 2012 (GUM 1067), and on undetermined decaying wood (GUM 1068); Saravan forest park, Rasht, on decaying wood of *Alnus* sp., 6 Aug. 2012 (GUM 1069), on decaying wood of *Mespilus germanica* (GUM 1070, 1071), and on undetermined decaying wood (GUM 1072); Saravan forest park, Rasht, on wood of *Parrotia persica*, 13 Aug. 2012 (GUM 1073, 1074, 1075); Golestan province, Imam Reza forest park, Kordkoy, on undetermined decaying wood, 11 Sept. 2012 (GUM 1076); Guilan province, Ghaleh-Roudkhan, Fouman, on wood of *Gleditschia caspica*, 11 Oct. 2012 (GUM 1077); Sefidab village, Rahim Abad, Roodsar, on undetermined decaying wood, 19 Oct. 2012 (GUM 1078); Saravan forest park, Rasht, on undetermined decaying wood, 25 Oct. 2012 (GUM 1079); Lonak, Lahijan, on undetermined decaying wood, 9 Nov. 2012 (GUM 1080, 1081). All collected by S.A. Hashemi, except the 1080 and 1081 by M. Mousakhah and 1061 by V. Taherian.

Note: *Xylaria pannosa* was primarily established through a short description on a collection from Brazil (Lloyd 1918). It is mainly distinguished from the closest species, *X. cubensis*, by stromatal flesh (Rogers & Ju 2012). *Xylaria pannosa* is a new record for the mycobiota of Iran.

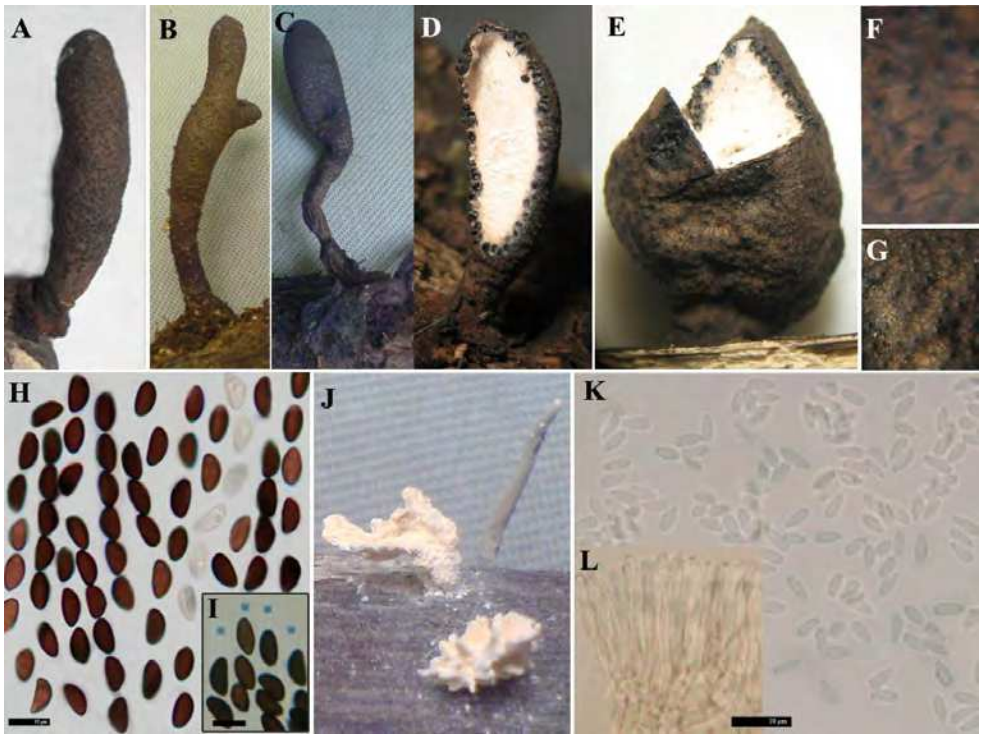

Fig. 7. *Xylaria pannosa*: A–E. Stromata on wood, F–G. Close-up of stromatal surface, H. Ascospores , I. Ascus apical rings bluing in Melzer's reagent, J. Anamorphic and teleomorphic states on wood, K–L. Conidia and conidiophores, respectively (Bars = 10 µm).

Xylaria polymorpha (Pers.) Grev., Fl. Edin.: 355 (1824) **(Fig. 8)**

Stromata unbranched to branched, extremely variable in shape and size, cylindrical, cylindric-clavate, irregular to rarely ellipsoid, with rounded fertile apices, stipe short, rarely long, (6.5–)13–92(–113) mm high × (2.5–)3–18.4(–24) mm broad (Fig. 8A); stromatal surface roughened with wrinkles, blackish brown to fuscous black (Fig. 8B); ostioles more or less papillate to hemispheric; perithecia completely immersed, 500–900 µm diam.; asci 8-spored, 180–230(–250) µm long × 65–68(–10) µm broad, the spore-bearing parts (80–)90–135(–140) µm, with ascus apical rings bluing in Melzer's iodine reagent, urn-shaped to rectangular to inverted hat shape, (4–)4.5–7(–8) × (3.5–)4–5 µm (Fig. 8D); ascospores brown, ellipsoid-inequilateral to navicular, with rounded to acute ends, (17.5–)18–24(–26) × (5.5–)6–8(–9) µm, with straight to slightly oblique germ-slits about ½ spore-length (Fig. 8C).

Specimens examined: Iran: Guilan province, Ghaleh-Roudkhan, Fouman, on wood of *Fraxinus* sp., 20 Apr. 2012 (GUM 1082), on undetermined decaying wood (GUM 1083, 1084) and on wood of *Fraxinus* sp. (GUM 1085); Imamzadeh Hashem forest park, Rasht, on undetermined decaying wood, 4 May 2012 (GUM 1086); IRAN, Ghaleh-Roudkhan, Fouman, on undetermined decaying wood, 27 Jul. 2012 (GUM 1087); Mazandaran province, Kashpel forest park, Chamestan, Noor, on wood of *Alnus* sp., 10 Sept. 2012 (GUM 1088); Guilan province, Visrood road, Shaft township, on wood of *Pterocarya fraxinifolia*, 4 Oct. 2012 (GUM 1089); Ghaleh-Roudkhan, Fouman, on undetermined decaying wood, 11 Oct. 2012 (GUM 1090, 1091), on wood of *Quercus* sp. (GUM *1092*), on wood of *Alnus* sp. (GUM 1093, 1094, 1095), and on wood of *Quercus* sp. (GUM 1096); Mazandaran province, Kashpel forest park, Chamestan, Noor, on wood of *Alnus* sp., 10 Sept. 2012 (GUM 1097); Guilan province, Saravan forest park, Rasht, on undetermined decaying wood, 18 Oct. 2012 (GUM 1098); Sefidab village, Rahim Abad, Roodsar , on wood of *Pterocarya fraxinifolia*, 19 Oct. 2012 (GUM 1099), on undetermined decaying wood (GUM 1100, 1101, 1102, 1104), and on wood of *Diospyros lotus* (GUM 1103); Saravan forest park, Rasht, on wood of *Parrotia persica*, 2 Nov. 2012 (GUM 1105); Ghaleh-Roudkhan, Fouman, on wood of *Platanus* sp., 3 Nov.

2012 (GUM 1106) and on undetermined decaying wood (GUM 1107); Lonak, Lahijan, on wood of *Zelkova* sp., 9 Nov. 2012 (GUM 1108, 1109); Saravan forest park, Rasht, on wood of *Parrotia persica*, 30 Nov. 2012 (GUM 1110, 1111); Saravan forest park, Rasht, on wood of *Quercus* sp., 7 Jan. 2013 (GUM 1112). All collected by S.A. Hashemi, except the 1105, 1108 and 1109 by M. Mousakhah.

Note: *Xylaria polymorpha*, mainly characterized by extremely variable stromata in shape and size, is the most frequently reported species from temperate regions of the world, and is considered as a complex species (Rogers & Callan 1986). *Xylaria polymorpha* has been previously reported from Ardabil, Golestan and Mazandaran provinces of Iran (Arefipour *et al.* 2004, Riedl & Ershad 1977, Soleimani 1976).

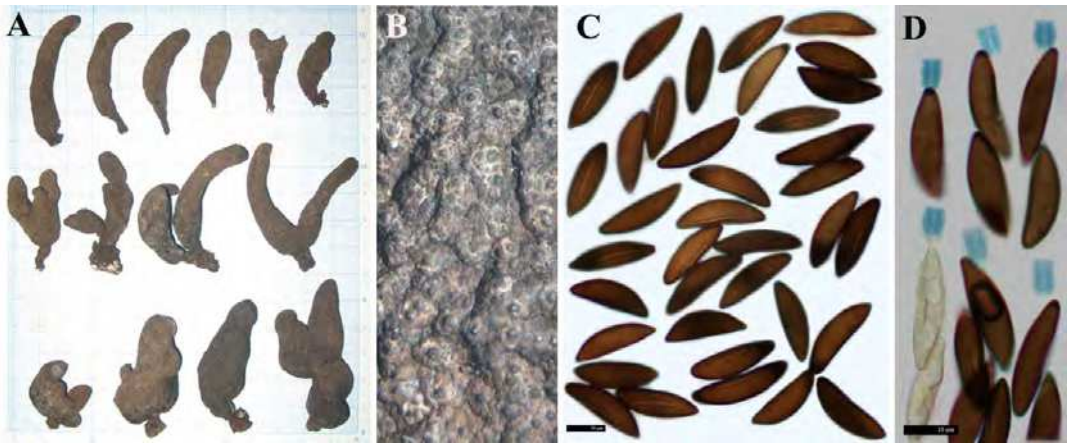

Fig. 8. *Xylaria polymorpha*: A. Stromata, B. Close-up of rough stromatal surface, C. Ascospores, D. Ascus apical ring bluing in Melzer's reagent (Bars = 10 µm).

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